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ECONOMIC COMMISSION FOR ASIA AND THE FAR EAST

CAMBODIA, LAOS, THAILAND AND VIET-NAM

Committee for Co-ordination of Investigations of
the Lower Mekong Basin
Sixteenth Session (Plenary)
3 - 8 January 1962
Phnom-Penh, Cambodia

MEKONG PROJECT

SEDIMENTATION SURVEY MISSION

Programme of work for 1962

by

Mr. B. DUSSART

Associate Professor, University of Paris,
Department of Geodynamic Researches,
Paris Faculty of Sciences Thonon

Chief, Hydrology and Sedimentation Survey Mission

FRENCH PERMANENT DELEGATION
TO ECAFE

FRENCH EMBASSY

No. 59/E

Bangkok, 30 December 1961

Dear Mr. Executive Agent,

I have the honour to forward to you, for the Sixteenth Session of the Mekong Committee, whose agenda includes the Tonle Sap Project, a report on the French Sedimentation Survey Mission.

The Mission started in October 1960 has effected so far a reconnaissance survey over a period of three months, from 15 October 1960 to 15 Janaury 1961.

During this mission, a field reconnaissance made it possible to delineate a preliminary programme of work for the estimatation of the rate of silting in the Great Lake, and to collect the basic data necessary to evaluate the present importance of sedimentation in that area.

A report submitted in February 1961 to the approval of the Mekong Committee and transmitted through you to all parties concerned included all data collected to date and indicated the main lines of further work to be done. This work includes two parts:

A. A first part, requiring collection of basic data on liquid discharges. This involves the following operations:

(1) To measure the discharge of the main tributaries of the Great Lake, in order to produce at least an approximate rating curve of those tributaries.

(2) To produce an approximate estimation of the complementary run-off discharge into the Great Lake and to determine whether such discharge is negligible or not.

(3) To collect and interpret all available.

/The survey work

Dr. C. Hart Schaaf
Executive Agent
Committee for Coordination of Investigations of the Lower Mekong Basin
ECAFE, Sala Santitham
Bangkok.

The survey work included in this first part should be conducted in close cooperation with the Cambodian hydrologists in charge of Great Lake surveys, in order to avoid any duplication and produce optimum results.

B. A second part, for which Mr. Dussart, Chief of the French Sedimentation Survey Mission on the Great Lake has drafted the programme of work which I am sending you herewith. It is understood that the French sedimentation survey Mission will work in close liaison and cooperation with the Indian Mission for the Tonle Sap Project, as well as with the other programmes participating in the preparation of the Tonle Sap Project.

I should be very grateful if you could forward this to the Committee members.

Yours sincerely,

(signed)

J.D. Paolini
Permanent representative of France
to E.C.A.F.E.

PROGRAMME OF WORK OF THE SEDIMENTATION SURVEY MISSION FOR 1962

The impending arrival in Cambodia (most probably on 15 January 1962) of Mr. J.P. Carbonnel, research agent of the French National Center for Scientific Research, appointed as Assistant to the Chief of the Sedimentation Survey Mission, enables us to envisage the implementation of the following programme in the near future:

1. Continuation of the 1960 reconnaissance survey:

(a) Collection of all currently available data on solid discharge of the Tonle Sap and of the principla stungs of the Great Lake already surveyed by other agencies (USOM, Harza, tec...), and study of solid discharges of other important tributaries of the Lake.

(b) Collection of all meteorological data, in order to evaluate the nature and importance of rainfall, erosion and sedimentation transport factors in the watersheds of the Great Lake tributaries.

(c) Analysis of physical properties, and possibly of chemical properties, of soils subject to erosion or sedimentation in the Great Lake area.

(d) Study of relationship between meteorological factors (winds, rains), the varying water level of the Great Lake, sedimentation transport capacity of tributaries and sedimentation.

2. Consideration of new problems, with a view to producting a general report in the near future:

(a) Study of sedimentation rate at different locations on the Great Lake and on the Tonle Sap, in particular on the Tonle Sap near the Snoc Trou Bar, in the Small Lake and in the Great Lake an also in the vicinity of the confluence of the main Great Lake tributaries.

(b) Study of the distribution of the various sedimentation strata in the whole basin area.

(c) Study of the action of currents in the tributaries and Lake on the distribution of such strata and on silting at various locations on the Great Lake.

/(d) Study of

(d) Study of silting rate in the Great Lake, and evaluation of the duration of survival of the Lake in the light of all the above data.

In order to implement that programme, the Sedimentation Survey Mission will have to contact anew all agencies currently collecting basic data, and continue the organization of the sedimentation laboratory which we had started to install during the preceding mission.

Furthermore, the close relationship between the sedimentation survey mission and the fisheries mission enables us to consider the study of correlation between the sedimentation rate in the Great Lake and the fish life in that area.

Suggestions for the programme of work for 1962 are as follows:

1. Every three months, in low-water, flood, high-water and decreasing flood periods, study of the solid discharge of tributaries, insofar as it is possible to estimate such solid discharges on the basis of simultaneous or previous analyses of liquid discharges.

2. Study of currents in the Great Lake in the winter monsoon, summer monsoon and trade-winds season.

3. In the low-water season, general study, through collection of samples, core drilling and field observations, of the nature and intensity of sedimentation, and survey of soils in the Great Lake area, in particular in the permanently submerged zone (Great Lake, Small Lake).

4. Analysis, in the sedimentation laboratory currently under organization, of samples collected, and preparation of a comprehensive report.

In order to carry out field observations, the sedimentation survey mission will need to have the necessary means of transport, in particular for the transport of sampling equipment, which is often quite heavy, and of bulky current measurement equipment.

The results should make it possible to evaluate the silting rate of the lake in present conditions.

/In the case

In the case of regulation of the water level in the Great Lake by means of a barrage on the Tonle Sap, such studies will also make it possible to evaluate the effect of the establishment of a limit-level of the water in the Great Lake, below which lateral sediment transport through direct action of the wind becomes important and determines the distribution of sediments brought in by the Great Lake tributaries (including the Tonle Sap).

The Mission will study a complete hydrologic cycle of the Tonle Sap, from low-water season to low-water season, and will endeavour to define the laws of sedimentation active in the area, as well as the correlation between:

Meteorological factors (rainfall, winds)
Hydrological factors (currents, in- and out-flowing discharges), and
Geodynamic factors (sediment transport, erosion, nature of materials transported and deposits)

Considering the importance of the contempleted investigations, it would be necessary to obtain from the local authorities all the physical assistance which the French Mission might not be able to provide, such as technical personnel for laboratory and field work, boats, etc...

Thonon, 22 December 1961

B. Dussart

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ECONOMIC COMMISSION FOR ASIA AND THE FAR EAST.

CAMBODIA, LAOS, THAILAND AND THE REPUBLIC OF VIET-NAM

Committee for Coordination of Investigations
of the Lower Mekong Basin

Sixteenth Session (Plenary)
3 - 8 January 1962
Phnom Penh, Cambodia

REPORT TO THE COORDINATION COMMITTEE
FROM T.M. POPE, SPECIAL REPRESENTATIVE OF CANADA
TO THE COMMITTEE

Present state of the Canadian contribution.

Because the terrain and detail in the area concerned have proved to be much more complex than estimated, it was not possible to complete the mapping by December 31, 1961. However, every effort is being made to complete the mapping promptly by pressing into service all the mapping equipment and personnal that can be mustered. This includes an important contribution of equipment and personnal from the Department of Mines and Technical Survey.

Particular attention is being given to those aspects of the mapping which are urgently required. In addition to accelerating this priority mapping Canada has agreed to provide the Coordination Committee with preliminary copies of the compilation manuscripts before these have passed final inspection. It is hoped that the Co-ordination Committee will have received much of the urgently required information by March 31, 1962.

The following is a survey of the progress on the top priority areas on December 14, 1961:

Nam Pong Tributary, Thailand - Hunting Survey Corporation Limited

This area comprising approximately 3,145 square kilometers is now being completed. Drafting and first proofing is approximately 55% complete and it is estimated that all drawing and first proofing will be completed by April 1st, 1962.

Preliminary information in either first proof or manuscript copy form has been delivered to the Co-ordination Committee and to Rogers International Corporation on instructions from the Executive Agent.

/Six sets of

Six sets of 1/10,000 scale semi-controlled mosaic sheets covering 1,035 square kilometers of this tributary have been produced and were delivered to the Executive Agent at the beginning of July, 1961.

Stung Battambang Tributary, Cambodia - Aero Surveys Limited

Horizontal and vertical bridging of this area of approximately 1,950 square kilometers is complete and compilation is now in progress. It isestimated that preliminary copies of the compilation manuscripts will be available for delivery by January 31st, 1962. It is estimated that drafting to the first proof stage will likely be completed by March 31st, 1962.

The 1/10,000 scale semi-controlled mosaicing of an area of approximately 810 square kilometers as requested by the Co-ordination Committee was being prepared in Mid-December and delivery was expected to be made by approximately December 31st, 1961. Hunting has been instructed to deliver two sets of these mosaic sheets to SOGREAH, Phnom Penh and two sets to the Executive Agent via air freight and two sets to the Executive Agent via sea freight.

Nam Ngum Tributary, Laos - Hunting Survey Corporation Limited

Horizontal and vertical bridging of an area of approximately 3,000 square kilometers is now in progress and it was estimated that the bridging operation would be completed by December 31st, 1961. Compilation will commence as soon as adjusted control data is available, which was estimated at Mid-December to be before the end of December, 1961. It is estimated that compilation will be completed by March 31st, 1962 and delivery of copies of compilation manuscripts as advance information is expected by that date. Completion of drafting up to the first proof state is estimated for June 30th, 1962.

Horizontal control for use in the preparation of 1/10,000 scale semi-controlled mosaics of approximately 1,700 square kilometers will be obtained from the bridging mentioned above. It was estimated that mosaicing would commence before December 31st, 1961, and would be completed by approximately January 31st, 1962. Delivery of six sets of copies of mosaic sheets will be made as instructed by the Executive Agent.

Pa Mong Reservoir, Thailand and Laos - Canadian Aero Service Limited

Compilation of this reservoir area is in progress and is approximately 30% complete. Completion of the compilation is estimated for January 31st, 1962 at which time preliminary copies of the compilation manuscripts will be made available to the Executive Agent. It is estimated that drafting to the first proof stage will be completed by March 31st, 1962.

No mosaicing is required in this area.

Sambor Dam Site, Cambodia - Canadian Aero Service Limited and Spartan Air Services Limited

An area of 70 square kilometers of 1/2,000 scale mapping totalling 54 sheets is being produced jointly by the above mentioned companies.

Canada Aero Service's portion of this work has reached the second proof stage and was to have been finalized before December 31st, 1961. Advance copies

/of 27 first proof

of 27 first proof sheets were supplied to the Executive Agent and the Australian Investigation Team (Snowy Mountain Authority) on August 14th, 1961.

Advance copies of Spartan compilation manuscripts of the remaining 29 sheets were shipped as requested by the Executive Agent on December 12th, 1961. Drafting is now in progress and first proofs of 5 sheets have just been received by Hunting. Advance copies of first proofs of drafted sheets can be delivered, if required, as soon as drafting is complete. First proofs are expected to be delivered by Spartan by January 15, 1962.

Se San Tributary - Viet-Nam - Canadian Aero Service Limited

Horizontal and vertical bridging to cover approximately one third of the required mapping area of this tributary was to have been completed by December 20th, 1961. Present scheduling indicates completion of compilation of the area which has been bridged by March 31st, 1962. Preliminary copies of compilation manuscripts are expected to be available as advance information by this date. Completion of drafting to first proof stage is estimated by April 30th, 1962.

In view of the fact that it will be impossible for Canadian Aero to commence the bridging phase of the remaining two thirds of the Se San area until after March 31st, 1962, a proposal has been made and agreed to that the Department of Mines and Technical Surveys assume the responsibility for the mapping of the remaining part of this tributary.

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of the Lower Mekong Basin
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3-8 January 1962
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FRENCH BAUXITE PROSPECTION MISSION IN THE LOWER MEKONG BASIN

PRELIMINARY REPORT

by Dr. H. CRUYS

Geology Expert of the French Bureau of Geological and Mining Researches,
Chief of Mission

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FRENCH BAUXITE PROSPECTION MISSION IN THE LOWER MEKONG BASIN

PRELIMINARY REPORT

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Chief of Mission

I. INTRODUCTION

Bauxite, a highly aluminous lateritic substance (with aluminum trihydrate or monohydrates) is the typical aluminum ore.

It is found in several genetic forms, of which the principal ones are the following:

(a) Bauxites which originated from large alluvial deposits of kaolin and clay or kaolinous shale, through weathering of large hinterland plateaux composed of masses of silico-aluminous rocks.

This type is found in particular in the coastal sedimentary series, of the tertiary or quaternary era, of Surinam and British Guiana.

(b) Bauxites formed "in situ" from alumino-silicated rocks, of eruptive or metamorphic origin and of widely differing age and petrographic nature.

The formation of bauxite is then due to a process of laterization usually preceded by profound clayey weathering of rocks producing mainly kaolinite, transformed into bauxite on location.

The various original rocks which produce aluminous laterites include:

- granites and gneisses, feldspathic hornfelses, rhyolites, syenites, diorites, porphyries, gabbros, norites, andesites, diabases, basalts, dolerites, phonolites, volcanic tuffs, amphibolites, shales, phyllites (Malaya, Indonesia, Sarawak, India, U.S.A., British and French Guianas, Surinam, Brazil, Guinea, Ghana, Nyassaland, Australia, Ireland, Germany).

/(c) Bauxites

(c) Bauxites associated to karstic surfaces which developped in formations of carbonated rocks (limestones and dolomites) of the tertiary, mesozoic and paleozoic eras.

(Jamaica, Haiti, France, Italy, Austria, Hungary, Yugoslavia, Rumania, Turkey, U.S.S.R., North Viet-Nam).

We may note that there are two theories concerning the origin of bauxite-yielding substances and the genesis of bauxite deposits:

(1) Native origin: bauxite deposits are formed from limestone or dolomite, through dissolution of those carbonated rocks. The raw material of bauxite would then be the "Terra Rossa", which is considered as a decalcification clay, a reddish and insoluble residual product of limestone and dolomite.

(2) Foreign ofigin: bauxites are formed from more or less kaolinous or lateritic alluvial deposits, which accumulated during emersion periods in the funnels and cavities in the karst of lime-dolomitic formations, through erosion of residual clays and laterized soils which developed on high-level masses of silico-aluminous rocks.

We may add that the above-mentioned rocks and substances would lead to the formation of bauxite (in ancient or recent times) only in special conditions, in particular from the point of view of climate and geomorphology, namely, in tropical areas with rainy seasons, and on morphologically favourable areas with a vegetal cover (plateaus, peneplains, domes, large slightly inclined slopes).

Purpose of the Mission

Reconnaissance of bauxite occurrences, first-phase prospection with a view to determining the possibilities of bauxite in the Lower Mekong Basin or in adjacent areas belonging to its economic sphere.

II. GEOLOGY AND RESEARCH. PROGRAMME OF WORK IN THAILAND

No special bauxite prospection has ever been attempted in Thai land. No occurrences of aluminous laterite have been reported so far.

/The Khorat

The Khorat Plateau includes the Thai part of the Lower Mekong Basin. By its geographic location, it may be of great interest as concerns bauxite. However, its geologic constitution is not favourable to bauxite possibilities. According to available geologic data, the "Khorat Series", a triassic and jurassic continental formation which covers that vast plateau, is composed essentially of lithological elements which cannot be considered as good mother-rocks for the formation of bauxite (sandstone, shale and quartzite conglomerate).

Further, on the basis of the literature and data we have been able to obtain from various departments in Bangkok, it would appear that certain specially favourable substances and mother-rocks are not found in that area, e.g. (a) sedimentary kaolin, clay and kaolinous shale; (b) gabbro or dolerite sills and large basalt or andesite outflows.

(Let us mention in this respect that no occurrence of aluminous laterite was found in the small basaltic outflows on the southern rim of the plateau).

In brief, we believe at present that the geology of that region, in so far as it is known today, does not justify research for bauxite on the Khorat Plateau.

In consequence, our reconnaissance work will be mainly concentrated in the adjacent area to the west of the Khorat Plateau, which we have provisionally delineated by the strategic landmarks of the three following dams (under investigation or under construction):

- Pa Mong (1,500,000 kW) on the Mekong, to the North-East
- Kang Riang (100,000 kW) on the Kwae Yai, to the South-West
- Yan Hee (560,000 kW) on the Nam Ping, to the North-West

This vast north-south oriented region includes several zones:

(a) The alluvial basin of the Nam Chao Phraya covers the middle part of the region.

On principle, this large basin might be considered for prospection of sub-alluvial bauxite deposits (see Type (a) mentioned in the Introduction).

/However, this

However, this type of deposit cannot be investigated at the present time, because such prospection would necessarily involve relatively long and specialized work, which could not be implemented during our first phase reconnaissance programme (relatively systematic surface prospection and geological surveys, completed by reconnaissance borings, and by geomorphologic and sedimentation studies).

(b) The eastern part, which borders upon the Khorat Plateau, and the western part of the selected area, could be investigated more rapidly. They include rugged areas with outcrops of a variety of rocks belonging to several geologic formations of different ages.

From the lithologic and stratigraphic viewpoint, certain of those rocks are prima facie favourable to the formation of aluminous laterites (see types (b) and (c) in the Introduction).

We may mention:

- the limestones of the "Ratburi" permo-carboniferous formation. Karstic processes have already been reported in that formation, in particular in the vicinity of Kanchanaburi.

(Let us mention in this respect that fossile lateritic formations, including true bauxites, are known to exist in the karstic masses of the permian limestones near Lang Son in North Viet-Nam).

- The granitic and dioritic rocks, andesites, basalts and porphyries of the various eruptive masses produced by the mesozoic and tertiary orogeneses.

(It may be worthwhile mentioning here that laboratory testing of samples collected in the red weathered clays of the basaltic Boloven plateau in Laos revealed relatively high alumina contents).

- In the absence of detailed geologic maps of those promising regions, the preliminary study of aerial photographs would be exceedingly useful. Together with the topographic mapping (scale 1/250,000 and 1/50,000), such photographs would enable us in particular to locate and delineate in those regions the

/most promising

most promising zones from the geologic and geomorphologic point of view, and possibly to spot those particular types of vegetation which are likely to be associated with outcrops of laterite caps.

The results of the photogeologic and morphologic surveys will be regularly checked by brief field reconnaissances of the successively selected areas, enabling us to complete at the same time the geologic documentation.

III. FIELD ORGANIZATION OF THE MISSION

(1) Immediately upon our arrival in Bangkok on 2 December 1961, we contacted various personalities concerned with the mission: Dr. C. Hart Schaaf, Dr. B. Binson, Mr. Sethaput, Dr. C.Y. Li, Mr. Saman Buravas, Mr. Nitipat Jalichandra.

(2) Prospection and camping equipment

We recently received part of our equipment from France. We expect to receive very soon the other essential part of our prospection equipment, which will be sent from Paris by air.

The camping equipment will be shipped by sea.

(3) Transport equipment

The all purpose Landrover vehicle (type 109) which we have ordered can be delivered only in late January 1962.

Realizing that we would not manage without a car in a large city like Bangkok and for our first field-trips, Mr. Vija Sethaput, Director of the Thai Department of Mines, gave us the loan of a new Landrover pending delivery of our own vehicle.

We wish to express our great appreciation to Mr. Sethaput for his very cooperative gesture and for his valuable technical assistance.

(4) Personnel

In accordance with the agreement, the Thai Department of Mines has appointed a young engineer, Mr. Sidhi Suddhibongse, to assist us, in particular during field missions.

/(6) Office Space

(6) Office Space

The Department of Mines has put at our disposal an office in its geology wing, where most of its engineers are working. However, our office is not large enough.

It would be desirable that an adequate office be made available to us in the near future to study the numerous aerial photographies and topographic maps, trace prospection charts and store samples and prospection equipment.

Bangkok, 30 December 1961

Dr. H. CRUYS
Geologist

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FRENCH BAUXITE PROSPECTION MISSION IN THE LOWER MEKONG BASIN

NOTE ON BAUXITE ANALYSES

by Dr. H. CRUYS,
Geology expert of the French Bureau of Geological and Mining Researches,
Chief of Mission

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NOTE ON BAUXITE ANALYSES

By Dr. H. CRUYS

Geology Expert of the French Bureau of Geological and Mining Researches,
Chief of Mission

LABORATORY WORK

1. Preparation of samples

Laterite samples are usually sent from the field in cloth bags (approximately 1 to 2 kg per bag). Field operators should fix a consignment label to each bag, so that the numbers of the samples may be conveniently inscribed in a reception register.

The samples are often wet. Therefore, before crushing, they must often be dried by placing the bags in a drying oven with a temperature not exceeding 120° centigrade. During the dry season, when the samples have been sufficiently dried in the sun, it is not necessary to place the bags in the drying oven.

After drying, the samples are crushed, ground and screened in a 100 mesh screen. If the grinding apparatus is well adjusted, a single operation should be sufficient. Any oversize will be held by the screen.

Part of the ground sample, say 100 to 150 g. is to be placed in cardboard or plastic boxes for storage. A label is placed in each box indicating the number of the sample as well as any other useful data such as the place and condition of sampling and the depth at which the sample was taken.

Another part of the ground sample, 10 to 20 g, is placed in a 50 cc beaker (with a number corresponding to the sample number) for chemical laboratory analyses.

/2. Drying of

2. Drying of samples

In the chemical laboratory, the samples in the 50 cc beakers are stoved in a drying oven during one hour at a temperature of 110° to 120° centigrade; the beakers are then removed from the oven, closed and left to cool in a dessicator during three hours, protected from humidity.

All weight determinations are done by a simple weighing operation.

3. Physical analysis - Determination of ignition loss

After the dried sample has cooled, 1 gram of powder is weighed in a covered, numbered, calcinated and tared silica crucible. The numbers of the crucibles, both full and empty should be listed down in special registers.

The crucibles are then placed in an oven heated at 1,000° centigrade, which temperature is maintained for one hour.

As soon as heating is discontinued, the crucibles are removed and placed to cool for two hours in a dessicator; they are then weighed.

We have:

$P_1 - P_2 \times 100 = H_2O$ %

4. Chemical analyses

While one gram of powder is being weighed for ignition loss, another gram of powder is also weighed for chemical analyses.

(a) Determination of total silica content - Three-acids method

Reaction solution:

485 cc H_2O
115 cc SO_4H_2
100 cc NO_3H
300 cc ClH

The second gram of powder is then placed in a 250 cc pyrex beaker, covered by a watch glass. The beaker will receive a label showing the sample number.

/This powder

This powder is then attacked by about 75 cc of the above-mentioned mixture of sulfuric, hydrochloric and nitric acid and water during a period of one, two or three hours according to the rate of reaction of the various samples, on a sand bath at a temperature of approximately 450° centigrade. The whole is then boiled until all elements become soluble apart from the silica and the reaction residue produces thick white fumes. After ten more minutes, the reaction may be considered completed.

The result is then withdrawn from the fire and left to cool; 80 to 100 cc of acidulated water is added (water containing 10 cc of hydrochloric acid per 1,000), and boiling is resumed for 5 minutes, after which a filtration is made over a gaged 250 cc pyrex phial.

Washing with boiling acidulated water is effected until the water closely corresponds to the gage mark. The filtrate is preserved. (When the filtrate is cool, 10 cc is removed for titanium determination. The remaining 240 cc of filtrate will be used for iron determination).

The filter containing the silica is not dried. It is introduced directly in a platinum crucible and calcinated at a heat of 1,000° centigrade, in an electric oven or on a gas oven. Calcination is continued for 30 minutes after the filter-paper has been burned to ashes.

The crucibles are left to cool on triangles, and are then placed in the dessicator when come to a temperature of about 40° centigrade.

After cooling, the crucible is weighed a first time, defining weight A_1 g.

Eight drops of 1/1 sulfuric acid are then added, and the crucible is half filled with hydrofloric acid. Evaporation is ensured by slow heating on a sand bath.

When the crucible is dry, gas calcination is effected again for 30 minutes to ensure evaporation of the silica in the form of volatile silicon fluoride.

The crucible is cooled in the dessicator. It is weighed again, showing weight A_2 g. The difference is the weight of the silica contained in the sample.

/We have

we have: $A_1 - A_2 \times 100 = SiO_2$ %

(b) Determination of Fe_2O_3

Iron is determinated by means of a solution of potassium bichromate in presence of diphenylamine or barium diphenylaminosulfonate as an indicator.

Stannous solution:

5 g Cl_2Sn in 100 cc ClH H_2O 1/1

Standard potassium bichromate solution, 5 g per litre.

Diphenylamine indicator:

1 g for 100 cc SO_4H_2

or barium diphenylaminosulfonate:

0.5 g for 100 cc H_2O

To the filtrate obtained in the determination of total silica content (after removing 10 cc of that filtrate for titanium determination) we add without heating to the remaining 240 cc of filtrate previously poured into an erlenmeyer flask, a few drops of MnO_4K at approximately N/10, until a permanent pink hue is obtained to destroy organic matter.

Then heat to approximately 50° centigrade and add 10 cc of concentrated ClH.

Heat is increased almost to boiling point, the liquid turns yellow.

Reduction is effected with a few drops of Cl_2Sn, and is completed when the liquid becomes colourless.

As the samples become discoloured, they are cooled to room temperature by immersion in a container of cold water.

After cooling, add:

- 10 cc of SO_4H_2 at 1/6
- 10 cc of PO_4H_3 at 1/3
- 10 cc of Cl_2Hg at 50 g per 1,000 cc

a white turbidity should appear.

/Then add:

Then add:

- 2 cc of barium diphenylaminosulfonate, pour $Cr_2O_7K_2$ at 5 g per 1,000 cc until a violet colouring shows that the reaction is completed.

$$\frac{5.585 \times 5 \times 250 \times 100 \times 160}{4.90 \times 1000 \times 240 \times 112} = A$$

$A \times B = Fe_2C_3$ %

B = number of cc of bichromate

A = 0.849 for B = 1 cc.

The above computations should be effected once and for all; in fact, B is read on the burette, and referred to a correspondence table.

(c) Determination of TiO_2

Titanium determination is effected by the colorimetric method (e.g. by means of the Dubosq tintometer).

We had previously taken a sample of 10 cc of the solution obtained after silica filtration, and diluted to 250 cc, which are introduced in the tintometer tube.

Add:

5 cc of PO_4H_3

10 cc of SO_4H_2 at 1/3

and also, just before introducing in the tintometer:

2 cc of H_2O_2 at 20 volumes.

Comparison is made with a type sample of TiO_2 solution (1 g per litre) through addition of the same quantities of phosphoric acid, sulfuric acid and hydrogen peroxide, and the final volume of the sample under assay is obtained by addition of distilled water. We then have:

$$c' = \frac{c \cdot 1 \times 250 \times 100}{1' \times 10} = TiO_2 g$$

c' = unknown strength

c = standard known TiO_2 strength (in grams)

1 = distance traversed by the light of the standard solution.

1' = length traversed by the light of the solution of unknown strength.

/d) Determination

(d) Determination of Al_2O_3

Al_2O_3 can be obtained by substraction:

$$100 - (H_2O\% + SiO_2\% + Fe_2O_3\% + TiO_2\%) = Al_2O_3\%$$

Results:

Ignition loss	
Total SiO_2	
TiO_2	
Fe_2O_3	
Al_2O_3 by substraction	
Total	100%

Bangkok, 8 January 1962

H. CRUYS
Geologist

ANNEX 1

VARIOUS SOLUTIONS USED

Reaction solution

Distilled water	485 cc
Sulfuric acid	115 cc
Hydrochloric acid	300 cc
Nitric acid	100 cc

Stannous solution

Distilled water	1,000 cc
Chloric acid	1,000 cc
Chrystallized stannous chloride	100 g

Mercuric Chloride

Mercuric Chloride	50 g
Distilled water	1,000 cc

Barium diphenylaminosufonate

Barium diphenylaminousulfonate	5 g
Distilled water	1,000 cc
Hydrochloric acid	25 cc

Standard potassium bichromate

Potassium bichromate	5 g
Distilled water	1,000 cc

Sulfuric acid 1/2

Distilled water	500 cc
Sulfuric acid	500 cc

Sulfuric acid 1/3

Distilled water	650 cc
Sulfuric acid	350 cc

Sulfuric acid 1/6

Distilled water	1,000 cc
Sulfuric acid	200 cc

Phosphoric acid 1/3

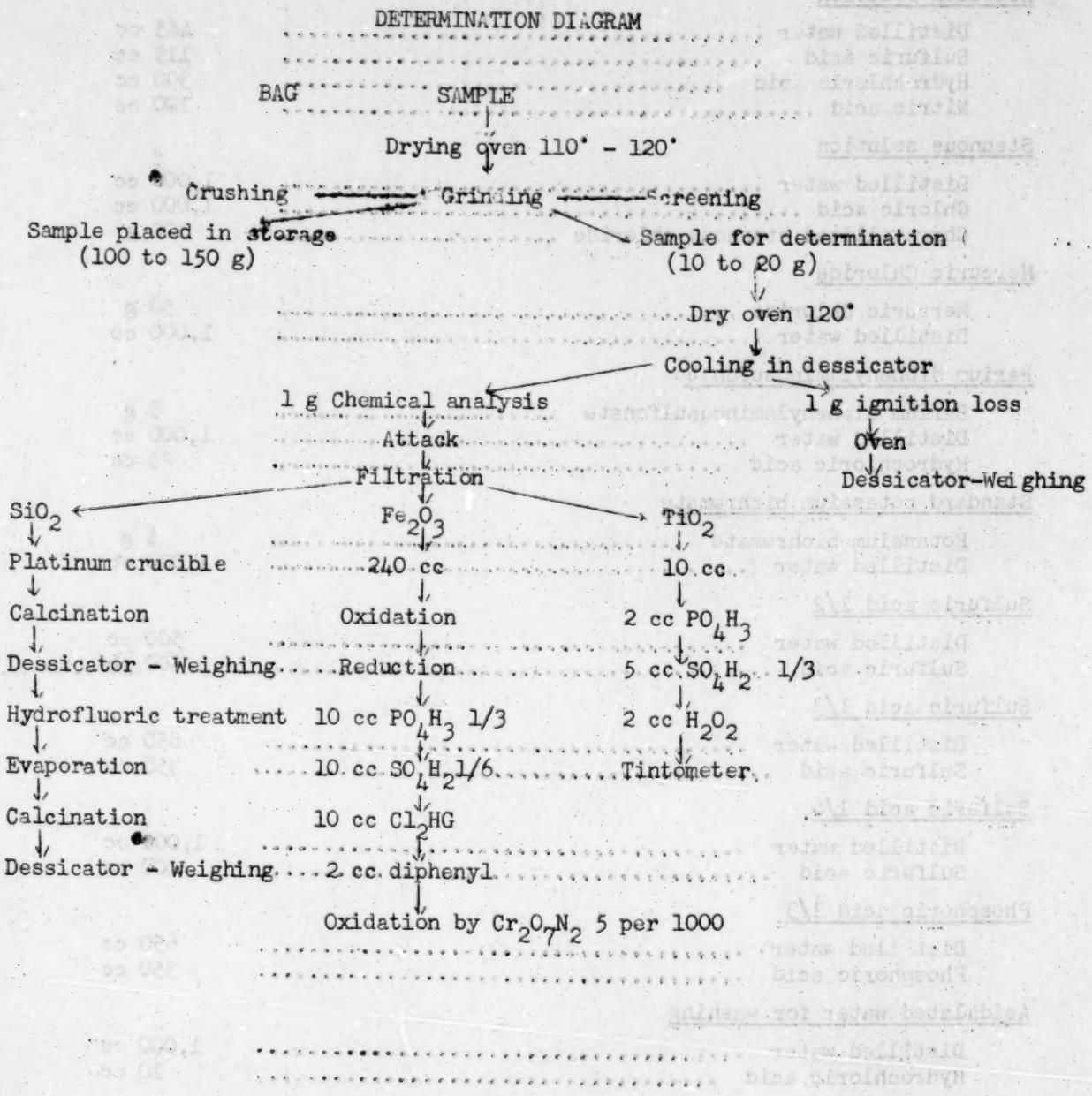
Distilled water	650 cc
Phosphoric acid	350 cc

Acidulated water for washing

Distilled water	1,000 cc
Hydrochloric acid	10 cc

ANNEX 2

DETERMINATION DIAGRAM



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Committee for Coordination of Investigations
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Sixteenth Session
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Phnom Penh, Cambodia

MEKONG PROJECT

FAO MISSION
for
FOREST AND GRASSLAND FIRE CONTROL

Preliminary Note

by G. Tondeur,

FAO Consultant provided to the Mekong Committee

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Forest and Grassland Fire Control

PRELIMINARY NOTE

by

G. TONDEUR

FAO Consultant provided to the Mekong Committee

This note precedes the report to be made at the end of the Mission.

It has two purposes: (1) to define the proposed guiding lines to be followed in carrying out the study, and (2) to make concrete proposals concerning the overall scheme for a long term action, and also covering several immediate actions of pilot character.

1. TERMS OF REFERENCE OF THE MISSION

The terms of reference of the Mission as determined by FAO are as follows:

"To prepare for the Mekong Coordinating Committee a programme of forest and grassland fire control, including the resettlement of certain populations, for the drainage areas in the four riparian countries, i.e. Thailand, Cambodia, Laos and Viet-Nam, with initial priority in the four tributaries selected as pilot projects."

2. ORIGIN OF THE MISSION: TURBANG REPORT (January 1961)

The Mission originates from the publication of the "FAO Report on forest and grassland Fires in the Lower Mekong Basin. Damage to land and water resources with special reference to the Mekong Development Project" by Mr. J. Turbang, FAO Forestry and Forest Products Division.

The main purpose of that Report was to determine the extent of damages observed and to express them, as far as possible, in monetary terms.

This first Mission, entrusted to Mr. Turbang, originated from the difficulties encountered during aerial photography operations owing to the presence, in certain seasons, of thick smoke coming from huge fires of the natural vegetation.

The Turbang Report emphasized the seriousness of the deterioration due both to fire and to various concomitant factors and affecting forests and soils as well as

/hydrological

hydrological and hydrographical conditions. This Report called for a logical follow-up: the study of correctives measures to remedy this situation. This study constitutes in turn the present Mission's terms of reference, the latter having been extended in order to cover final practical considerations, i.e. the preparation of a programme of forest and grassland fire control.

3. DISCUSSION OF THE TURBANG REPORT

The terms of reference of the present Mission do not include any further investigations to verify the conclusions of the Turbang Report.

Therefore, the Expert in charge of this Mission considers the conclusions of that Report as accepted. However, he makes the greatest reservations in this regard. In fact, due to incomplete and dissimilar statistical data used by the author for each of the four countries, as well as to divergences in the terminology used by the various parties concerned, the Reporter has not been able to proceed beyond a first approach to the problem. The author of the report had himself drawn attention to those points.

However, after field trips in Thailand and collection of further information, the expert definitely confirms the general conclusions of the previous reporter at least in so far as Thailand is concerned, i.e. the existence of a generalized phenomenon of accelerated deterioration of natural resources in the Mekong drainage area. This conclusion very probably also applies to the other three riparian countries.

The reservations stated concern only the supposed action of certain phenomena and the attempted estimation of annual losses.

4. EXTENT OF DETERIORATION OF RESOURCES

The phenomena observed must be interpreted, not in a static but in a dynamic conception. For several reasons, shown in this Report, their intensity will continue to increase from year to year, because of the cumulative effect of various unfavourable factors, unless remedial measures are taken.

Undoubtedly, they threaten the balanced development of the Mekong Project. In fact, they lead to accelerated deterioration of the potentialities of the zones to be developed by this Project in the fields of forestry, agriculture, water management and energy. The phenomena are all the more serious as this development - in the first period at least - will have to be based to a great extent on the

/marketing

marketing and processing of agricultural and forest products.

Hence, there would be a glaring contradiction between, on the one hand, all the means put into use for the harnessing of the river, and on the other, the lack of concern for the conservation of the resources to be developed by that same project.

Further, these phenomena have a more remote and wider repercussion, in the sense that - in the long run - they dangerously jeopardize the prospects of economic and social development of the four countries. In fact, they hasten the destruction of the productive potentialities of forests and soils, leading unavoidably to fatal imbalance between decreasing resources and expanding demography.

5. DISCUSSION OF THE MAIN PURPOSE OF THE MISSION: TO PREPARE A PROGRAMME OF FOREST AND GRASSLAND FIRE CONTROL

The importance given by FAO to this matter having its origin in reports dealing with fire, this factor is predominant in the definition of the Mission's terms of reference. Considered in its literal and narrow sense, this objective is limited to the recommendation of technical methods and laws and regulations for the control of vegetation fire and thereby for the control of deterioration of natural resources.

That amounts to assuming in principle that fire is the sole element which brings about deterioration, or at least, an element which could be isolated from the others, with regard as much to its causes as to its effects, and that its control might be the objective of a special technical programme.

It should be noted in this respect that the Turbang Report already mentioned certain other factors of deterioration of natural resources. The previous experience and local observations of the Expert in charge of this Mission confirm his conviction that all factors of forest and soil deterioration are closely interdependent. It is not possible to control one without dealing with the others. This reasoning leads to a much wider interpretation of the terms of reference of the Mission: conservation and, if possible, improvement of natural resources through the control of all deterioration factors. This is the interpretation adopted by the Expert, who therefore recommends an integrated approach to the problem and justifies his recommendation as follows: among deterioration factors,

/shifting

shifting cultivation, overstocking and forest grazing, excessive forest exploitation (legal or illegal), are in the forefront. Though often associated with fire, they can have very serious consequences even without the direct action of fire.

Moreover, fire alone is not a primary cause of degradation - at least in the prevailing ecological forest types of the Mekong basin (i.e. dry Dipterocarp forests, semi-evergreen and evergreen forest). - It has an effect only when associated with other factors. Only pine forests can be seriously affected by direct, destructive action of fire. But pine forests, whatever may their economic future, occupy only an insignificant percentage of the territories considered.

6. SOCIO-ECONOMIC APPROACH TO THE PROBLEM

Analysis of the various aforementioned deterioration factors shows that their primary causes are not fire but the behavious of certain human communities with regard to natural resources upon which they depend for their subsistence and, in some cases, for all or part of their economic activities.

Though the secondary causes of the phenomena observed are ascribable to technics, the primary causes depend on human motivations and attitudes, i.e. economics or sociology, and even psychology.

This consideration goes beyond the problem of resettlement of populations recommended in the terms of reference of the Mission and constituting in fact a social means for fire control.

It rather tends to suggest a socio-economic approach to the whole problem, coordinated with the technical approach.

Indeed, it is obvious that, to produce efficient results, efforts must be concentrated on the primary causes (human factors) and not on the secondary causes (fire, shifting cultivation, etc.).

It is no use recommending technical measures and enforcement of regulations to protect and improve the forests, if both are incompatible with imperative motivations resulting from the way of life of the populations, their subsistence, their only economic possibilities and their demographic expansion.

In consequence, the protection of forests necessitates a profound modification of the attitudes, motivations and behaviour of human communities which are the primary cause of forest deterioration. This involves in particular:

/(i) giving up

(i) giving up the customary practices of shifting cultivation and adoption of new practices;

(ii) giving up customary practices in animal husbandry and adoption of new practices;

(iii) developing new practices to be proposed to the populations and satisfying the sine qua non condition of better remuneration for the farmer's labour and better economic prospects;

(iv) acceptance, by the populations involved, of a new kind of life associated with these practices;

(v) modification and diversification of economic activities, in particular the plant and animal productions that might bring about an evolution in nutritional habits and the opening of new commercial outlets;

(vi) development of employment in the sectors of industry and services, with a view to absorbing the population increase.

7. DISCUSSION OF THE SECONDARY PURPOSE OF THE MISSION: RESETTLEMENT OF POPULATIONS

The Expert believes that this objective can be achieved in two ways.

(i) moving the populations out of the zones to be protected and resettling them elsewhere;

(ii) resettling, or rather settling, the populations in situ within the zone to be protected, according to a formula compatible with the conservation of natural resources.

The first conception is hardly acceptable. In fact, if the wider interpretation of the main object of the Mission is accepted, the problem of natural resources conservation concerns the entire Mekong Basin, and not only certain particular areas of that Basin. Consequently, displacing populations would be merely displacing the problem, unless the resettlement takes place in zones where conservation farming is already being practiced. Such would be the case, for example, of resettling shifting cultivators of the mountains in the rice areas of the deltas and the wide irrigated valleys. However, there would be in this case not only a financial and technical problem (development of new rice-fields) but also demographic and social problems, for it may be feared that the demographic expansion of the rural populations living in the lowlands might lead to a saturation of these lands within a more or less near future and makeit very

/unsuitable

unsuitable to bring in additional populations from outside. Moreover, there are possibilities of ethnical conflicts due to different populations being brought together, or of the nomadic cultivators, in particular those from the mountains, showing a dislike for the new kind of life proposed to them.

Finally, the problem should be considered in its widest scope, and not from the narrow angle of partial achievements. In ot er words, it is necessary to find solutions which still hold when applied to the whole lower Mekong Basin. Therefore, though moving the populations practising shifting cultivation can be a practical solution for the protection and management of a small drainage area, it becomes an economic and social heresy when its general application is considered. The balanced development of the Mekong basin involves in fact the rational development of the potentialities of the highlands as well as of the lowlands, and the diversification of production; neither of those two objectives are compatible with the concentration of populations in the rice fields of the deltas and the large irrigation schemes.

The Expert consequently recommends a system of in situ resettlement of nomadic cultivators in a permanent form of farming. Of course this system may also involve short-distance displacements for the protection of particularly critical areas or for the exploitation of small local hydraulic projects.

This in situ resettlement involves the conversion of extensive farming, destructive of natural resources, into intensive and conservation farming. This will necessarily raise a number of economic, financial, social, and even political problems.

As for the technical aspects, they are far from solved. Everyone recognizes the need, for the conservation of resources, to put an end to shifting cultivation, but, for the Mekong basin, nobody can say exactly what alternative practices would be appropriate to local conditions, apart from irrigated rice cultivation.

To throw light on all these problems, integrated regional studies are necessary. They should be accompanied by pilot operation centres, in view of detailed investigations and experimental implementation of the proposed programmes. Re-orientation and intensification of research in the field of agronomy and forestry as applied to the highlands are also indispensable.

/8. LONG-TERM

8. LONG-TERM PROGRAMME OF WORK

The ultimate purpose of the action considered is the protection and improvement of forests through profound modification of the current methods of agricultural, forest and pastoral exploitation. Such action would have to be implemented in all high-level areas of the Lower Mekong Basin.

Such an ambitious programme can be implemented only by stages, for various financial, economic, technical and social reasons.

By stages means intensive action limited at the beginning to restricted pilot areas to be progressively extended, and not an extensive action progressively intensified, right away covering the whole territory.

Therefore, the Expert recommends the following programme of work:

(i) overall reconnaissance to determine the various regional 'types' or aspects of the problems to be solved, taking into consideration ecologic, demographic, sociologic and economic factors;

(ii) subdivision of the territory into zones presenting similar characteristics;

(iii) selection, for each zone, of a pilot physiographic unit, representative of the characteristic problems prevailing in the zone;

(iv) integrated study of this physiographic unit;

(v) selection, in each pilot physiographic unit, of a pilot sector for implementation with a view to experimental application, development and demonstration of the recommended practices, as well as for the training of officials who will extend the work beyond the pilot sector;

(vi) operation of the pilot sector, coordinated with the integrated study of the physiographic unit, until the practices are finally perfected;

(vii) progressive extension to the whole territory, taking into consideration:

- human and financial resources
- psychological factors (the more or less easy acceptance of the proposed programme by the rural population)
- economic factors:
  - parallel development and diversification of home or foreign markets for agricultural and forest products
  - parallel development of the secondary and tertiary sectors of economy (industries and services), so as to absorb the demographic

/increase

increase while developing and diversifying the home market.

9. INITIAL PROGRAMME

It would have been convenient if the present Mission could have:

(1) covered the following items of the above general programme:
  (i) overall reconnaissance,
  (ii) subdivision into zones presenting similar characteristics,
  (iii) selection, for each zone, of the pilot physiographic unit,
  (iv) selection, per pilot physiographic unit, of the pilot sector for implementation;
(2) made proposals and cost estimates relating to immediate operations covering the following items:
  (i) integrated survey of the pilot physiographic units;
  (ii) set-up and operation of the pilot sectors.

This has not been possible, for the following reasons:

(1) The necessity to broaden the terms of reference became obvious only after the activities of the Mission were started. The Mission was not designed to meet the requirements of these broader terms of reference and therefore had neither the required time nor the staff to follow these logical lines.
(2) The insecurity still prevailing in some parts of the Lower Mekong Basin impeded the action of the Mission.

It must be pointed out that the logical lines of the theoretical programme as outlined above do not exactly comply with the Mission's terms of reference, which implicitly recommend a more or less equal distribution of action in all four riparian countries, with the location of such action to be undertaken by priority in the watersheds of the four pilot tributaries selected for first implementation of hydraulic projects.

Such 'a priori' distribution of operations would lead to locate, in the watershed of each of the pilot tributaries, the integrated survey of one pilot physiographic unit and the set-up of the corresponding pilot implementation sector, without taking into consideration the fact that this may result in duplications (the pilot programmes in one country dealing with exactly the same problems as those in another) while some very important problems might be neglected because they are not present in the watersheds of the pilot tributaries.

/In order

In order to conciliate these various points of view and also taking into consideration both the limited means of the present mission and the conditions of insecurity in some parts of the area, the Expert suggests to proceed as follows:

1. To entrust to a subsequent mission the systematic implementation of the initial programme outlined above;

2. To limit present objectives to partial execution of this programme, in close conformity however with its basic principles;

3. Along these lines - without attempting to carry out a systematic survey leading to the subdivision of the whole area into zones presenting similar characteristics - to select some typical aspects of the problem, applicable to large areas, and propose for each one the integrated survey of a pilot physiographic unit as well as the set-up of the corresponding implementation sector;

4. Not to endeavour for the moment to conform with the principle of a balanced distribution of operations among the four riparian countries, it being understood that it will be the duty of the subsequent mission suggested above to prepare new proposals resulting in a better balance.

10. CONCLUSION

The above considerations indicate that a programme of forest and grassland fire control can be planned only within the broader framework of coordinated control of all factors related to deterioration of forests and soils.

It has also been shown that the investigation and implementation of such an expanded programme require an integrated approach in which social and economic considerations are associated with technical requirements.

The area to be covered by such a programme should comprise the whole highland areas of the four countries, excluding only the lowlands, deltas and areas of large irrigation schemes.

The highlands most often have a prevailing vocation for forestry: they are for the most part covered with forests, which are more or less deeply altered by the action of man, and are in some cases very badly deteriorated.

Moreover, the highlands constitute the watersheds of all the Lower Mekong Basin tributaries, the hydrographic regimes of which are directly connected with the irrigation of the lowlands, energy production, reservoir sedimentation, flood control and inland navigation.

/Therefore

Therefore, the programmes suggested should be directed towards protection, improvement and economic development of forests as well as towards watershed management.

Nevertheless, in order to be really efficient, they must take into consideration the imperative social and economic prerequisites connected with the agricultural and pastoral activities of the local people, who should be allowed to remain on location.

These activities, in turn, will require appropriate organization in order to be implemented without impeding the development of sound forestry and watershed management, while providing better economic prospects for the farmers.

In view of the broadening of its terms of reference, the present Mission will not be able to prepare an overall programme of systematic investigations implementation along the above main lines.

The preparation of such a programme will have to be entrusted to a subsequent mission. In the meantime, the present Mission will recommend the implementation of certain preliminary operations selected in such a way as to fit into the overall programme.

As concerns Thailand the Mission proposes to suggest the integrated survey of a pilot physiographic unit constituted by the watershed of the Nam Soen, an upper reach tributary of the Nam Pong. This unit is representative of conditions prevailing in a vast area of the Korat plateau.

A community development pilot centre including several judiciously selected villages might be suggested within that unit.

The Mission will endeavour to submit similar suggestions for Cambodia and, if possible, Laos and Viet-Nam.

G. Tondeur
Bangkok, 24 December 1961.

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French Fisheries Mission in Cambodia

PROGRESS REPORT

by

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French Fisheries Mission in Cambodia

PROGRESS REPORT

for period 15 October 1961 - 1 January 1962

Since 15 October 1961 the Fisheries Mission has been carrying out experimental fishing on the Tonle Sap as well as control checks on various fisheries.

With the agreement and assistance of Mr. Dom-Savoeun, Director of Fisheries, we have been able to use two days at Km 9 on the Tonle Sap. Those days have been under constant inspection, including the weighing of all fish captured; this will enable us to determine the exact dates and hours of passage of the various species. The fish migrate during periods of rising moon; the last migration, which occurred from 15 to 22 December, was the most productive. During those six days the captured fish had to be collected every 10 minutes. This work was made possible thanks to the cooperation of 12 fishermen and 4 technical assistants for the weighing and measuring operations. The most abundant fish is Cirrhinus auratus, which represented 31 tons out of the total catch of 50 tons.

Dissections showed that certain Cyprinidae such as:

Leptobarbus heevanii
Labeo chrysonhekadion
Osteochilus melanonlaura
Puntius altus
Puntius bulu
Puntius bramaides

were still in their breeding period. We also noted that Aloses (Clupea thibaudeaui) were in the process of maturation. Analysis of results will be effected during the months of January and February.

Daily physico-chemical measurements on the Mekong and Tonle Sap are being regularly continued. Sharp differences have been observed since the inversion of the Tonle Sap current, in particular as concerns dissolved oxygen.

Meanwhile, we had discussions with Mr. Kanwar Sain and Mr. Krishnamurthy concerning the project for a barrage on the Tonle Sap. Those discussions were mainly concerned with the problem of regulation of the two water-stages, upstream and downstream of the barrage, during the flood period migration.

/PERSONNEL

PERSONNEL:

The botanical investigation of the inundated forest will be resumed at the end of January 1962, as soon as the botanical expert, Mr. Schmid, returns to the area. This survey will be carried out in several missions of a duration of three weeks to one month each.

On 15 January, a technical assistant will arrive to complete the personnel of the Fisheries Mission. We will then recruit the necessary personnel (driver, interpreter, fishermen) to form a second team.

M. Blanc, Deputy Director of the National Institute of Natural History of Paris, will come to the area on a two-month mission at some appropriate time, when investigations reach their most important phase.

EQUIPMENT:

A turbine jet boat has been purchased to enable us to investigate the inundated forest and the rapids. The boat will be at our disposal as from 10 January 1962. A 15 HP outboard engine will complete the equipment for our two collapsible boats.

The programme of work defined in our October Progress Report has been implemented, and no modification of that programme is envisaged for the next two months. The programme of work for botanical investigations will be submitted to the Committee by Mr. Schmid immediately upon his return.